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ABSTRACT

In the changing world of today, man has created alarming imbalances of nature which threaten all living creatures of the earth. The public is becoming aware that severe measures must be taken to correct these imbalances. Indian people are closely attuned to their lands and resources--it is part of their traditional culture to have close ties with and appreciation for the soil, trees and plants, water, wildlife, clean air, mountains, the sea, and all the beauties of nature. With this kind of appreciation, teachers of Indian children can readily implement activities related to environmental improvement. This booklet was designed to help teachers and students in learning of the relationship of the environment to the human race. Divided into 5 major sections of activities, each activity is classified according to the level for which it is best suited. Symbols such as PRI for primary, INT for intermediate, and JH for junior high designate the level. Included are illustrations of simple experiments that can be conducted in the areas of soil and water; plant life; weather and air; fish, wildlife, and microscopic life; and forests, rangeland, and watersheds. (EJ)

ENVIRONMENTAL AWARENESS

AN ACTION APPROACH

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BUREAU OF INDIAN AFFAIRS
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This booklet is essentially a revision of "Classroom Activities Related to Natural Resources" by Edgar L. Wight, Helen Payne, and Golden Kilburn.

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Edgar L. Wight, Director
Instructional Service Center

Table of Contents

NOTE: Each activity is classified according to the level for which it is best suited. However, many of the demonstrations can be adapted to meet other grade levels. The following symbols are used to designate grade levels:

PRI — Primary Grades
INT — Intermediate Grades
JH — Junior High School
SH — Senior High School
A — Adults

Preface

In the changing world of today man has created alarming imbalances of nature which threaten the lives of all living creatures of the earth. The public is becoming aware that something is wrong, and that severe measures must be taken to correct these imbalances. It is important to establish in the minds of all, an awareness of the necessity of maintaining a healthful environment. Challenging and interesting educational approaches are necessary if the job is to be done effectively.

Indian people are closely attuned to their lands and resources — it is part of their traditional culture to have close ties with and appreciation for the soil, trees and plants, water, wildlife, clean air, mountains, the sea, and all the beauties of nature. With this kind of appreciation universally apparent among Indian students, teachers of Indian children can readily develop and implement interesting activities related to environmental improvement. In many cases such activities will stimulate immediate constructive responses leading to greater understanding, appreciation, and restoration of a clean environment.

Most teachers and students learn better by seeing and doing than just by hearing. In teaching about the environment, the wise teacher has an excellent opportunity to instruct by visual means both indoors and outside. When it is impossible to teach out of doors, materials from outside can be used in the classroom. Rocks, twigs, insects, soil, water, and wildlife are all portable and can be used to make learning interesting and effective.

This booklet was specifically designed for teachers and students to help them in learning the relationships of soil, water, plants, rocks, microscopic life, and wildlife to the human race. The activities were selected to aid the teachers and students in beginning a project without too much equipment and preparation. The subject matter can be as limited or broad as the situation dictates and should aid students, teachers and Indian families in productive community action projects which will restore and improve the country in which they live.

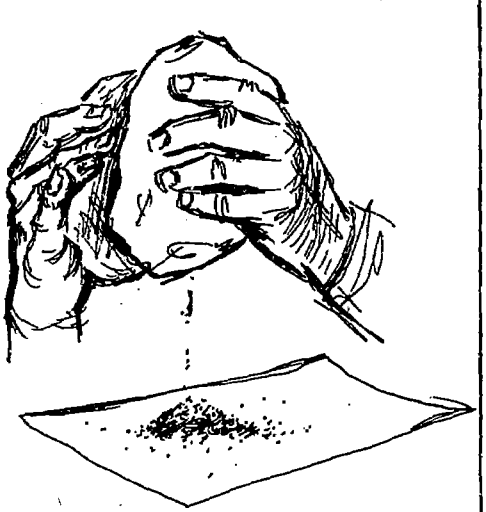
3

A

Activities Related to Soil and Water

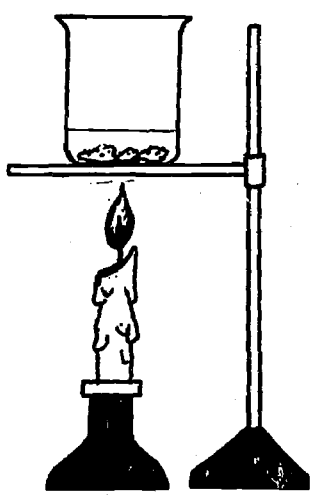
1. ROCK MAY BE WORN AWAY BY FRICTION

By rubbing rocks together or using sandpaper, children may see the beginning of soil formation. This will lead them to a better understanding of the long period required in soil forming. (PRI, INT)



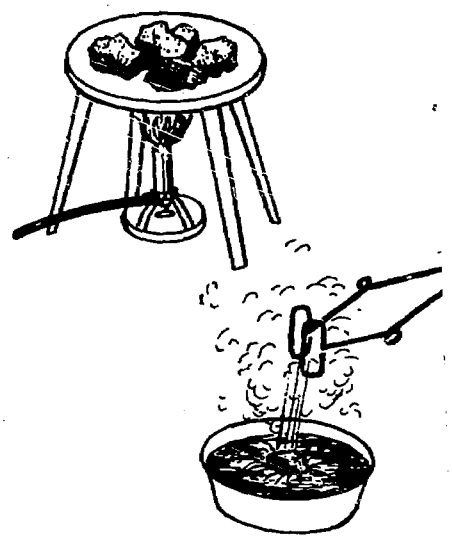
2. CHEMICAL ACTION DECOMPOSES ROCKS

Put a few pieces of limestone or marble in a small amount of vinegar. Heat the vinegar and notice the formation of bubbles on the rocks, which demonstrates the presence of lime and also the effect of acid upon limestone and marble. As water absorbs carbon dioxide from the air and also from plant roots carbonic acid is formed. This acid decomposes limestone and marble. (JH, SH)



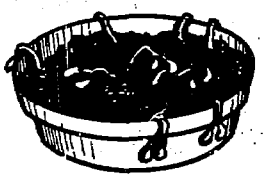
3. THE NATURAL FORCES OF HEAT ON THE EARTH

Place several stone samples on a metal stand over a Bunsen burner. Allow the stones to heat until they are very hot. Then pick each stone up with a pair of tongs, drop it in a pan of ice-cold water. What has happened to the stones? Why has this happened? What effect does this have upon the earth? Where do events like this occur naturally? (PRI, JR, SH)



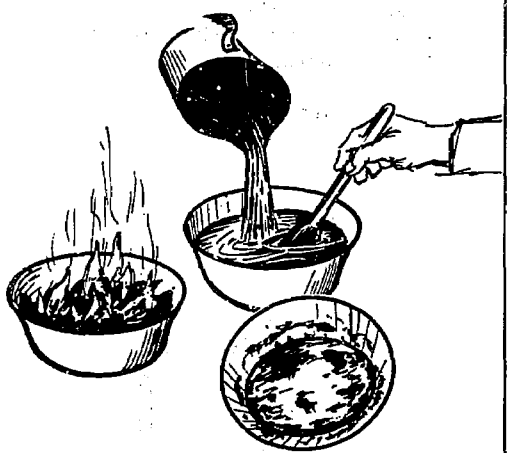
4. BROKEN ROCK IS NOT TRUE SOIL

Prove that broken rock is not soil. Crush some rocks, plant seeds, water them. The plants will soon die after the energy from the seed has been used up. (INT, JH)



5. PLANTS TAKE MINERALS FROM SOIL

Burn some leaves in a container. Pour water over ashes and mix thoroughly. Let water evaporate and observe mineral deposit on sides and bottom of container. (JH, SH)



6. HOW TO CLASSIFY A ROCK COLLECTION BY TEXTURE

Divide your specimens of rocks into four groups: Course-grained, fine-grained, irregularly-grained, and glassy. If you do not have examples of every group, make as many groups as you can.

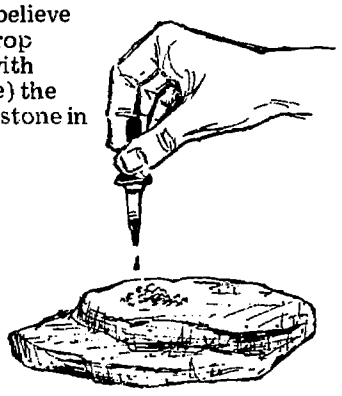
After you have classified your collection by texture, look again at the grains in each specimen. Use a magnifying glass if possible. Are all the grains in a given specimen alike? If not, are they different in shape? In smoothness? In shine? In color? In any other ways? See Rock Classification Guide on next page. (SH)

ROCK CLASSIFICATION GUIDE

Specimen	Texture	Grains	Description of Grains
A	Course-grained	3 kinds	Some grains irregular, transparent, and glassy Some grains with square sides, pink, smooth Some grains oblong, shiny, black
B	Irregularly-grained	2 kinds	Some grains the size and appearance of sand Some grains like pebbles the size of grapes, white and brown
C	Fine-grained	1 kind	All grains gray and fine as powder
D	Glassy	No Grains	No grains visible even under magnifying glass. Specimen looks like piece of smoked glass

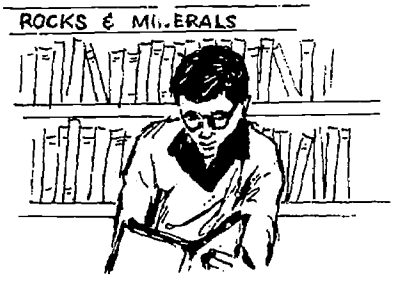
7. HOW TO RECOGNIZE LIMESTONE

Put a drop of diluted hydrochloric acid on the rock which you believe might be limestone. If the drop begins to bubble furiously with escaping gas (carbon dioxide) the rock is limestone or has limestone in it. (JH, SH)



8. SUGGESTED BOOK ON ROCKS AND MINERALS

If you have found any rocks and minerals that you cannot name, look up, "Field Book of Common Rocks and Minerals," by F. B. Loomis. This is a simple guidebook for the amateur collector. There are many other books on rocks and minerals equally as helpful. (JH, SH)



9. HOW TO SEPARATE SAND, SILT, AND CLAY PARTICLES

Pour a cup of water into a pint jar. Then put in 1/2 cup of soil. Put a cover on the jar and shake it for about 30 seconds. Let it stand until the soil settles. Can you see layers of mud in the jar? Can you see a layer of clay? A layer of silt? A layer of sand? Write names of layers of soil. (Most of the sand particles will settle first in about 1 minute. Silt particles will settle in about 5 minutes. Clay particles will take much longer to settle. After sand and silt have settled perhaps you can pour water containing clay into another jar and allow the clay to settle.) (JH, SH)

10. PLAN A FIELD TRIP

Organize and plan a field trip to study virgin soils and cultivated soils. Provide spades and soil augers for each group of students. Choose a "Captain" or scribe for each group and make definite assignments at different field locations for each party. Bring all students together to discuss their findings before moving to a new location. (INT, JH, SH)

11. EXPLORE A BROOK

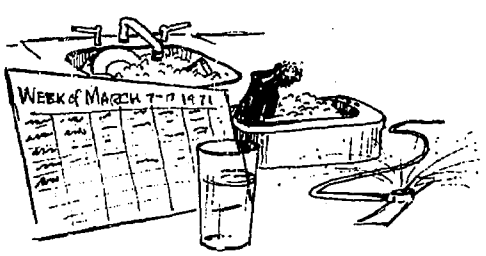
Explore a brook or small stream for a half a mile. Make a sketch map of its course and notes of your observations regarding various speeds of water, depth and width of channel, bottom, banks, rocks, vegetation, fish, insects. Note particularly signs of erosion and transportation of soil. (INT, JH, SH)

12. YOUR SCHOOL GROUNDS

What conditions are found on the school grounds in your community and county? Are there evidences of erosion? Have the grounds been beautified? If so, how and by whom? If not, why not? If the grounds are in need of improvements, make a plan for the needed improvements. Discuss plans in class. Make an effort to see that your plan, or some other plan equally as desirable, is carried out. (SH)

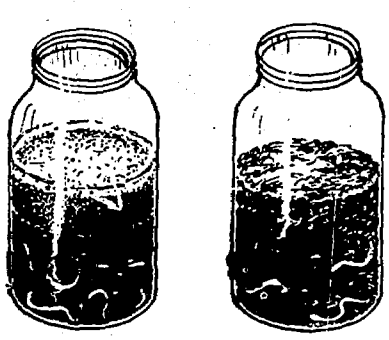
13. IS WATER IMPORTANT?

Keep a record of all the ways you use water during one week. (INT, JH)



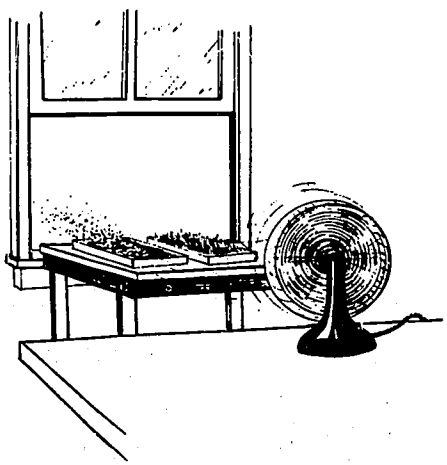
14. WHAT EARTHWORMS DO TO THE SOIL

Place several earthworms in the bottom of a glass jar. Add three or four inches of loose black earth. Cover the earth with about the same amount of white sand or sawdust. Scatter a little corn meal on the surface and soak the mixture with about a quarter of a cup of water. Set the jar in a paper bag to keep it dark so that the worms will work near the glass. Moisten the mixture a little each day. Take daily observations on what happens to the white sand or sawdust. This will show you clearly how earthworms cultivate the soil. (INT, JH, SH)



15. DEMONSTRATE WIND-EROSION

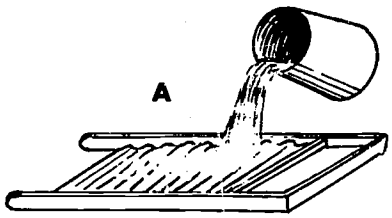
Use electric fan or vacuum cleaner attachment to show how wind will blow unprotected soil. A sample of bare soil and one of protected soil with straw or grass will show how unprotected soil erodes and how surface cover prevents the soil from blowing away. Use pinion pine, juniper, or brush twigs (6-7" high) to build miniature windbreaks on the unprotected soil. (INT, JH, SH)



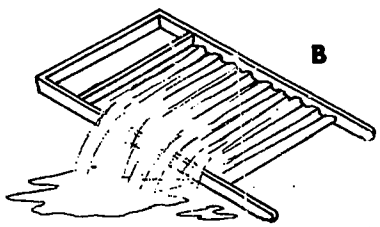
16. CONTOUR RIDGES SAVE SOIL AND WATER

To show this use a washboard and water in the following ways:

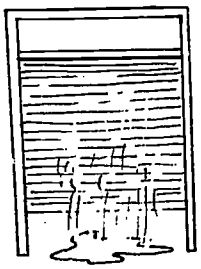
(a) Hold washboard nearly flat with ridges horizontal and pour on water. This illustrates the amount of water contour plow furrows hold.



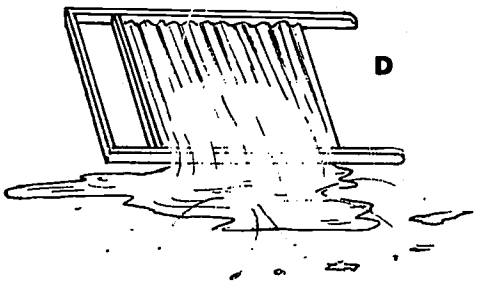
(b) Next, tilt the washboard slightly to show the effects of rows not quite on the countour.



(c) Hold the board at a steeper angle but with ridges horizontal. Notice that the furrows still hold water and that the run-off is slower.



(d) Hold the board at a gentle angle with ridges vertical and pour on the water. This represents up-and-down tillage which wastes water and causes erosion. (JH, SH)

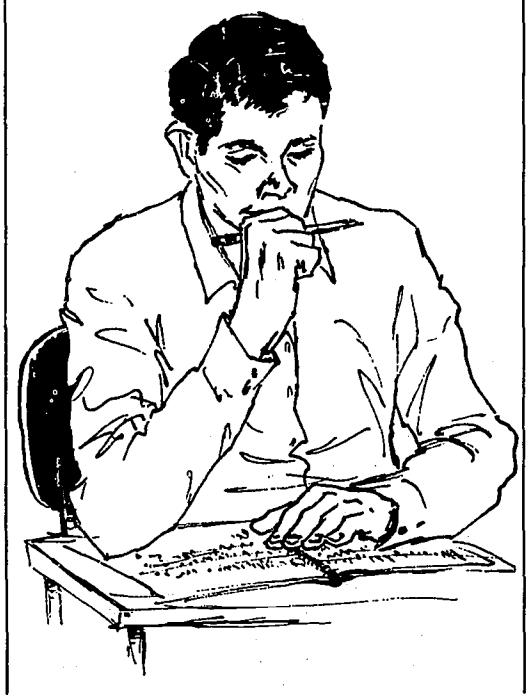


17. AN ARITHMETIC PROBLEM

The transporting ability of running water varies as the sixth power of the velocity. The formula is expressed thus $T=V^6$. If water is moving down a more or less bare slope at a velocity of one inch per second, the T (or transporting ability of the water)= IXIXIXIXIXI, or T=1. For this study, assume that at this rate some soil will be moved.

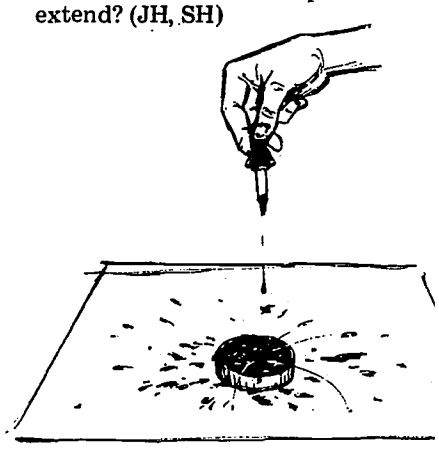
If the water were moving twice as fast, 2 inches per second, what would its transporting power be? How many times as much soil could be moved?

Supposing after a cloudburst or after a heavy rain or melting snow, the water were flowing at the rate of 100 inches per second (less than 6 miles per hour). What would its transporting power be compared to the first case? Does the answer to this question explain that big gully on the north side of the reservation? Does it help explain why small storms falling on unprotected fields, cause so many gullies and so much soil loss? (SH, A)



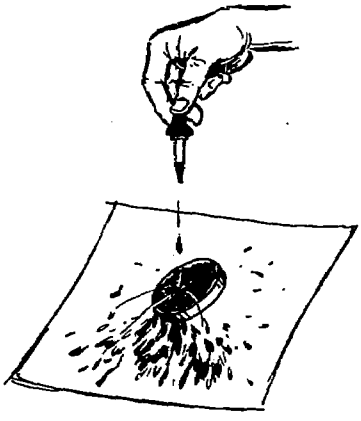
18. TO DEMONSTRATE RAINDROP IMPACT

Set a jar lid, or saucer of soil in the center of a large sheet (two or three feet square) of paper or cardboard. Release a few drops of water from a height of several feet so they strike the soil. Examine the paper. Do the shattered drops carry soil with them? How far does the splash extend? (JH, SH)



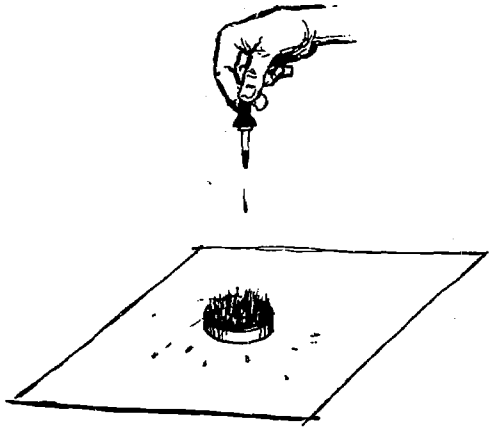
19. RAINDROPS (Cont.)

Repeat, placing both soil and new paper at a sharp angle to represent a sloping field. Observe the difference in splash down-hill and up-hill. How do you account for the fact that streams running from level farmland appear muddy after rains? (JH, SH)



20. RAINDROPS (Cont.)

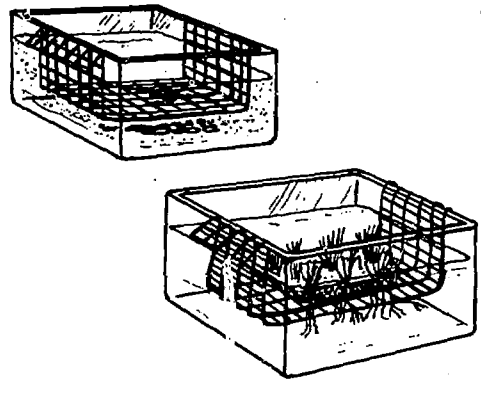
Repeat the experiment with sod-covered soil. Do the shattered drops carry soil? Does the splash extend as far as in the case of the bare soil? (JH, SH)



21. ROOTS HOLD SOIL IN PLACE

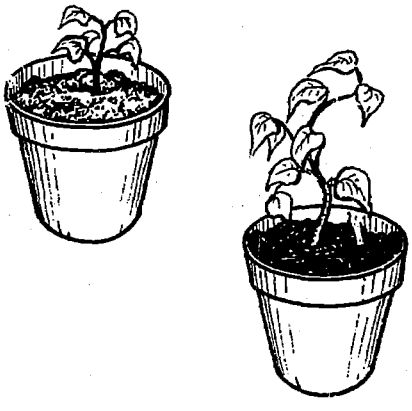
Use two large glass jars or fish bowls (with wide tops). Build a wire screen (1/4" mesh or 1/2" mesh) to fit "U" shaped into each jar. The bottom of the screen should extend 1/2 to 2/3 of the distance to the bottom of the jar. Fill the two bowls 2/3 full of water.

Select an area nearby where good grass is growing, with some spots where nothing is growing due to over-grazing or trampling. The soils should be the same in either case. Cut a small square of sod and soil from the grassy area and another block of the same size from the bare area. Put the samples on the wire screens and then place them in the water-filled jars. The bare soil will disintegrate and settle to the bottom making the water muddy. The root-filled soil will remain in place and the water will stay clear. What does this tell you about the cause of floods? Why do many of our water storage reservoirs fill with silt? (INT, JH, SH)



22. TOPSOIL IS MORE FERTILE THAN SUBSOIL

Into one flower pot put moist surface soil; into another put subsoil. Plant some seeds in each. Keep the pots watered and compare the growth. The plants in the subsoil will soon stop growing while the topsoil plants will continue. This shows why some hillsides and high points in fields are less productive than the lower lands. Erosion has taken the topsoil off the high lands. (PRI, INT, JH)



23. ORGANIC MATTER AFFECTS THE STRUCTURE OF SOIL

Make mud cakes using the following consistencies: 2/3 clay to 1/3 sawdust; 2/3 sand to 1/3 sawdust; 2/3 loam to 1/3 sawdust; clay alone. Moisten enough to mold well. Dry and then crumble each mold, noting differences in ease of breaking. (INT, JH, SH)

24. SOIL CONTAINS WATER

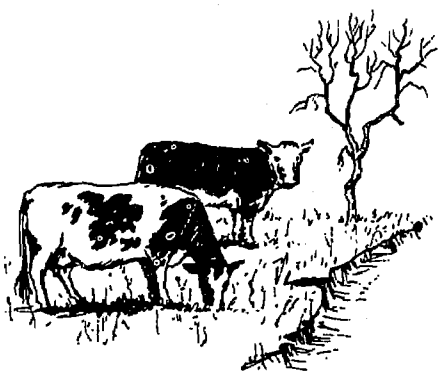
Partially fill a pyrex nursing bottle with seemingly dry soil. Heat the soil and note the drops of water which form inside the bottle. (INT, JH)

25. SOIL CONTAINS AIR

Fill a jar half full of soil. Then fill the jar with water and note the air bubbles. Different soils hold different amounts of air. (Refer to activity No. 78) (INT, JH)

26. PLAN ANOTHER FIELD TRIP

Take a field trip to a worn-out eroded field. Observe the cattle grazing in a pasture. What plants do they ignore? Compare the animals on the good and poor land as to appearance and development. (JH, SH)



27. WHICH KIND OF SOIL IS BEST?

Collect three kinds of soil; (1) good topsoil from a garden, old fence row, or unplowed pasture, (2) soil from an eroded hillside, and (3) subsoil from a depth of three or four feet. Put each sample in a flower pot or tin can. Label. Plant seeds in each. Water as needed. Watch the plants grow. From this test, decide which kind of soil is best for growing crops. (PRI, INT)

28. EXAMINE WATER PENETRATION

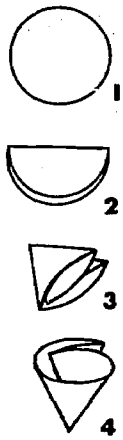
After a rain that follows a dry period, find out how deep water penetrates soils of different kinds. This may be done by turning soil or digging into soil with a spade. Make examinations in at least three places: in forest soil, or in soil covered with grass, on bare hard soil, and on a steep hillside. (JH, SH)

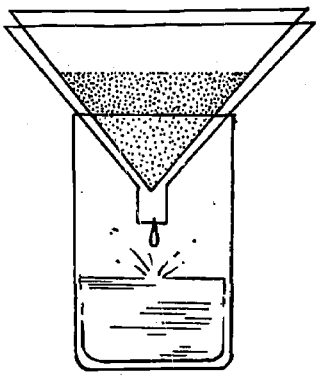
29. MAKE SOME HUMUS

Put a sample of moist soil with dead leaves on it in a small jar. Have children watch to see how long it takes to disintegrate leaves and become soil. Keep moist. This is called humus or leaf mold. (INT, JH)

30. MUDDY WATER MADE CLEAR

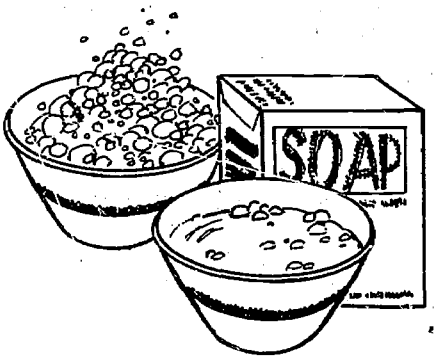
Place a teaspoonful of fine soil in a glassful of water. Cover the glass tightly and shake well. Place the glass of muddy water on a table and watch it for several minutes. Can you see the particles of soil? Are they rising or falling in the quiet water? Do some of them settle to the bottom? Do all of them settle to the bottom? Next, fold a filter paper as shown, and fit into a glass funnel and watch it seep through the paper. Catch some of the water in a clean glass. Does the filter paper remove any of the mud? Does it remove all the mud? (INT, JH)





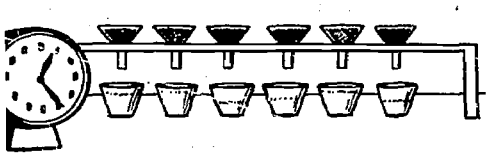
31. HARD WATER AND SOFT WATER

Take a dish of salt water and a dish of rain water. Test them with soap to see which is hard and which is soft. It will be much easier to make a great deal of soap suds in the rain water.



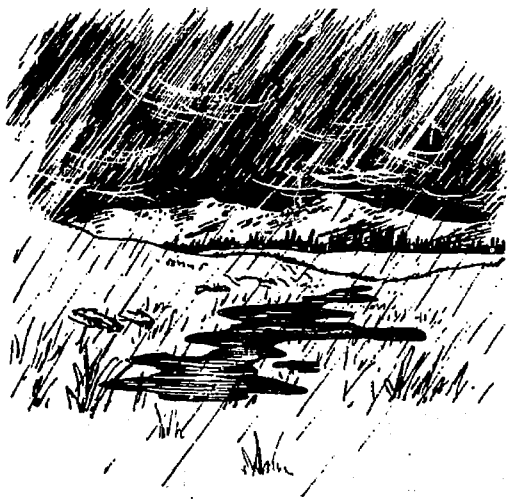
32. DETERMINE THE WATER-HOLDING ABILITY OF VARIOUS KINDS OF SOIL

Fill funnels of equal size with equal volumes of gravel, sand, subsoil, barren topsoil (from unproductive farm lands), rich topsoil, leaf mold from a forest floor, and dry leaves. Be sure that each of these is perfectly dry. Then pour equal amounts of water on them and measure the amount that runs through in a definite period of time. Explain the results you find. (JH, SH)



33. RAINSTORMS AND MUDDY WATER

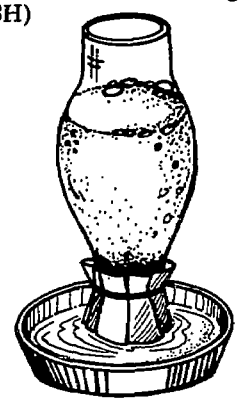
Have pupils note how muddy water is after a heavy rainstorm. Collect muddy water and observe how much soil settles to the bottom of the container. What should be done to prevent such loss of soil by water? (INT, JH)



34. WATER TRAVELS UPWARD IN SOIL DUE TO CAPILLARY ACTION

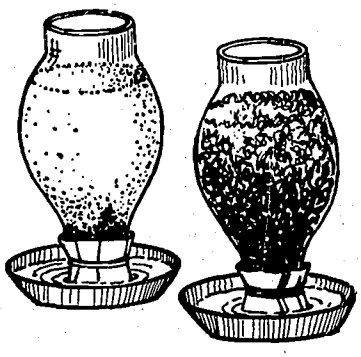
To show that water rises in soil, tie a very thin piece of cloth over the bottom of a lamp chimney 3/4 filled with soil. Set the chimney in a small amount of water. Observe upward movement of water. This is due to the attraction of the soil molecules for the water molecules, or capillary attraction. The tiny air spaces in the soil act as capillary tubes.

Also put a narrow strip of white cloth in some colored water. Because of capillary action, the water will work upwards into the cloth. A porous rock will likewise demonstrate this. Also use blotting paper. (JH, SH)



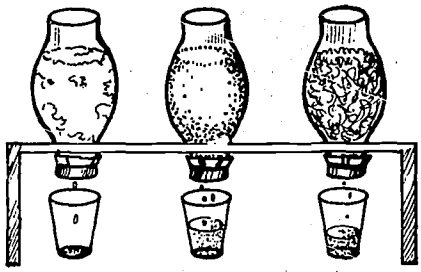
35. WATER RISES FASTER IN LOOSE SOIL

Fill two lamp chimneys with soil, packing one and stirring the other. Tie a thin piece of cloth over the bottom of each chimney. Place in dishes of water. Observe the chimney in which the water reaches the top first. Because of capillary attraction, the water will rise in the soil. It will penetrate the loosely packed soil first due to spaces between soil particles. (INT, JH)



36. WATER PERCOLATES THROUGH SOME SOILS MORE READILY THAN THROUGH OTHERS

Tie or tape cheese cloth over one end of each of three lamp chimneys or open glass cylinders. Fill first container 3/4 full with dry clay, the second with sand, and the third with loam containing humus. Pour 1/2 pint of water into each at the same time. Compare the length of time for percolation and the amount of water that passes through. (INT, JH, SH)



37. SOIL CONSERVATION PROJECTS (GENERAL)

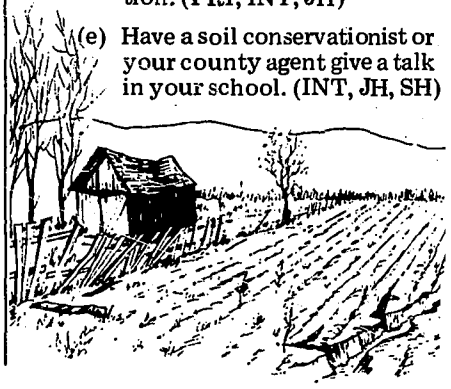
(a) Have members of class attend meetings of the soil conservation district governing body and report to class. (JH, SH)

(b) Write a brief statement of approximately 300 words on "What Conservation Means to Me." (JH, SH)

(c) Write a member of the board of supervisors of your nearest soil conservation district and invite him to attend and participate in some of your classes. (JH, SH)

(d) Prepare posters and exhibits on soil and water conservation. (PRI, INT, JH)

(e) Have a soil conservationist or your county agent give a talk in your school. (INT, JH, SH)



(f) Have children make a book or record of soil conservation activities. (INT, JH)

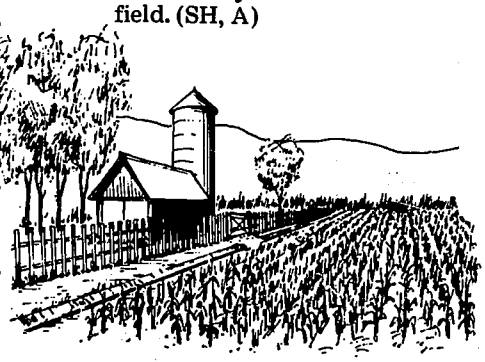
(g) Conduct classroom experiments and demonstrations on soil conservation. (INT, JH, SH)

(h) Organize field trips to see the cause, effects and control of erosion. (PRI, INT, JH, SH)

(i) Have students plan their own field trips. (JH, SH)

(j) Have students collect samples of soils, grasses, etc., and use in classroom experiments. (INT, JH, SH)

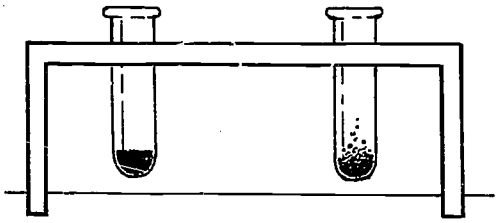
(k) Have advanced students make maps of farms and plan a rotation system for each field. (SH, A)



38. TEST FOR LIME IN SOILS

The purpose of this demonstration is to show the presence or absence of lime in the soil.

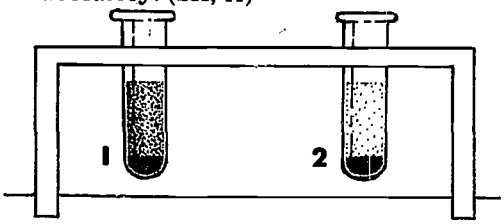
Collect two samples of soil, one which is high in limestone and one which has little or no limestone in it. Place a small amount of soil (about 1/2 tsp.) from sample No. 1 in a small test tube. Add a similar amount of soil No. 2 to another test tube. Now add a few drops of diluted hydrochloric acid to each. Watch the reaction. The one which contains lime will have a hissing or bubbling effect which shows the presence of lime and the release of carbon dioxide. Sample No. 2, which is low in lime, will have very little or no bubbling or hissing, which shows it is low in lime. (SH, A)



39. TEST FOR BLACK ALKALI IN SOILS

The purpose of this test is to show the presence or absence of black alkali in soils.

Collect two samples of soil, one from a poorly drained area where the soil looks slick, where the water does not penetrate easily, and where very few plants are growing. This soil may range from dark gray to a dark brown in color and usually contains black alkali. Select a second sample of soil from a well drained productive land. Add a small amount (1/2 tsp.) of soil No. 1 to a clean test tube or other suitable container. Add an equal amount of soil No. 2 to another test tube. Add distilled water to each test tube. Fill it half full. Shake each test tube well for a few seconds. Then let them stand for a few minutes. To each sample add a few drops of phenolphthalein (an indicator) which will turn the solution to a pink, red, or reddish purple when black alkali is present. Soil No. 2, which is free of black alkali will not show any change of color when this solution is added. The phenolphthalein can be obtained through the Soils Department of the State Agricultural College or from almost any chemistry laboratory. (SH, A)



40. TEST FOR SALT IN SOIL

The purpose of this test is to determine whether or not there is salt in soil. Low-land soils in many of the western States, especially in the Great Basin, carry a high percentage of salt (NaCI). Salty soils do not permit good plant growth, therefore, it is necessary before crops are planted to know if the soil contains too much salt.

Select one sample of soil from areas where the salt content is suspected to be high. Select a second sample where the soil is free from salt. Place a small sample (1/2 tsp.) of each soil into separate test tubes. Fill each test tube about 2/3 full of distilled water. Place stopper in tube and shake. Let stand a few seconds then add to each a few drops of diluted silver nitrate. Care should be taken in use of silver nitrate. If it comes in contact with the skin or eyes it may cause severe burns. Soil No. 1 will become cloudy if salt is present. This cloudy effect is due to the salt in the soil uniting with the silver nitrate which forms silver chloride. Silver chloride is very insoluble in water and in time will settle. Soil sample No. 2 will show no cloudiness.

For a color effect, add a few drops of potassium chromate to each sample. Soil No. 1, which showed the presence of salt by cloudiness, will turn to a light yellow. Soil No. 2, where there is no salt, will turn to a reddish brown color. Even though the colors are beautiful, do not drink. (SH, A)

41. TEST FOR SALT IN WATER

Collect two samples of water; one suspected of containing salt and one which is free from salt (distilled water such as used for automobile batteries). Place a few drops of silver nitrate in each of the samples of water. The sample of distilled water will remain quite clear. If salt is present in the other sample, the water will become very cloudy.

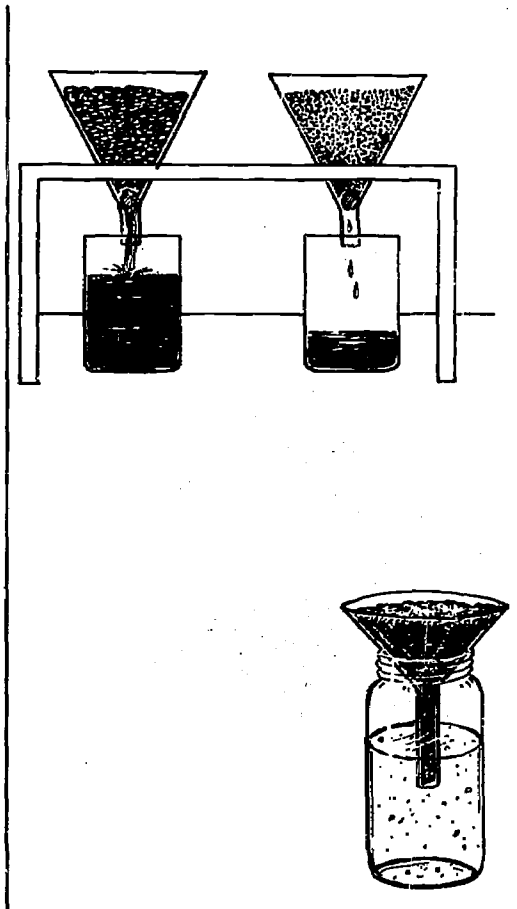
In order to bring about a color effect which is very interesting to see, add a few drops of potassium chromate. The salt-free sample will show a bright reddish brown color. The sample which showed the cloudiness may turn to a light ylelow. Care should be exercised in using both the silver nitrate and potassium chromate since they are both poison. (SH, A)

42. WATER-HOLDING CAPACITY OF SOILS

The purpose of this demonstration is to show how much water various kinds of soils will hold.

Get two funnels (plastic or glass) of equal size. At the neck of each funnel place a small piece of steel wool, wire screen, or coarse cotton about the size of a dime and press it down to prevent the soil samples from running through. Put about 50 c.c. of pea gravel ranging from 1/16" to 1/4" in diameter in one funnel. In the other funnel, place the same amount of clean sand. Be sure that each sample is perfectly dry. Place the filled funnels in a funnel rack with an empty glass under each one to catch any water which may run through. Now pour equal amounts of water on to each sample and measure the amount of water which runs through. Notice that the course material or gravel would not hold nearly as much water as the sand.

This same experiment can be carried on with loam, clay, leaf mold, and rich topsoil, but will take a longer time. Each soil particle has a film of water around it, therefore, the finer the particles, the more water it will hold since there is more air space to fill. (SH, A)



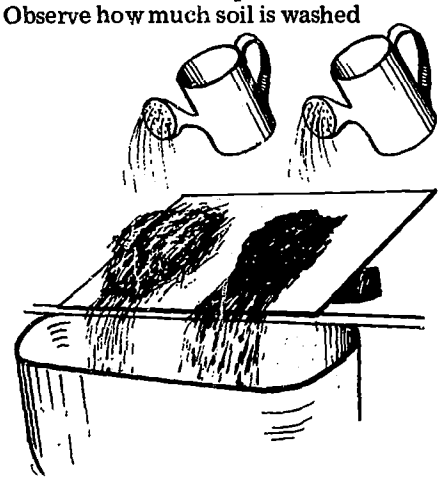
43. HOW SALT FORMS ON THE SURFACE OF SOIL

This demonstration takes about seven to ten days to complete. It makes a good observation demonstration for the school room.

Get a 7" or 8" long glass funnel about 3" wide at the top. Place a small piece of steel wool in the bottom of the funnel stem. Put sandy loam soil into the funnel to about 3/4 full. Add the soil slowly so that it will fill the stem of the funnel also. Place the funnel filled with soil (stem down) in a quart fruit jar which is about 1/2 full of salt water (4 tbsp. of salt to pint of water) so that the stem is well below the surface of the water. The salt water will rise in the soil through the stem of the funnel. This is known as capillary action. This action continues until the soil becomes completely wet. As the water begins to evaporate from the top of the soil, it will leave the white salt on the surface. After this has stood for some ten days and a good covering of salt has gathered on the surface of the soil, the salt can again be washed down through the soil by placing the funnel in an empty jar and adding fresh water to the surface of the soil. (SH, A)

44. PLANT COVER PREVENTS SOIL EROSION

From your school yard or nearby roadside, collect two bucketfuls of bare soil. Empty the buckets of soil into two piles on a large piece of plywood or large flat board (approximately 4′ by 3′). Steel or aluminum sheets may also be used for this purpose. Shape each pile of soil into a mound. Tilt each board to form a gentle slope. To one mound of soil, apply an organic covering such as straw, sawdust, peat moss, forest duff, leaf mold, or clipped grass. By means of two sprinkling cans with one gallon of water in each, apply the same amount of artificial rain to each pile of soil. Observe how much soil is washed from the unprotected mound as compared to the one having protected cover.



This demonstration can be performed on a much more accurate basis by weighing each soil sample and collecting and measuring run off from each sample. (SH, A)

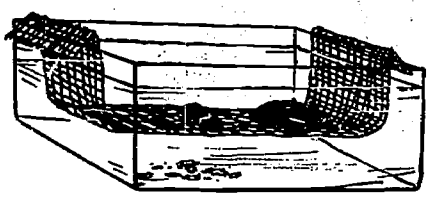
45. THE VALUE OF ORGANIC MATTER IN HOLDING SOIL MOISTURE

Select two samples of soil; one containing a great amount of organic matter such as virgin topsoil from ungrazed rangeland or practical forest land, the other sample can be selected nearby from the cultivated field where most of the topsoil has washed away.

Put one pound of each sample on a tin pie plate and stir with a flat spatula or knife blade. Then add water slowly to the virgin sample stirring slowly as the water is adde Continue this until the soil will ho no more water. Weigh the sample again to find the increase in weigh Repeat the operation with the cultivated soil sample. Do not allo any free water. Which sample held more water? How does organic matter affect the water-holding capacity of soil? (JH, SH, A)

46. THE VALUES OF LIQUID MANURE

Select a clod of clay loam soil. Break the clod into two pieces about 1 1/4" cubes. Now place about 1/2 pint of concentrated liquid barnyard manure in a dish which is deep enough to cover one of the clods. Let this clod remain in the liquid for one minute, then, with a broad-nosed forcep or tong remove it and put it onto a 1/4" mesh along with the dry clod which was broken from the same piece. Apply water in equal amounts with a sprinkler to both clods, or place the clods under water. Note the results carefully. Which one of the clods breaks up first? (SH, A)

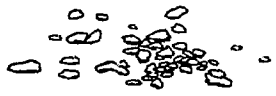


47. SOIL TEXTURE

To identify the texture of some of the main types of soil.

Most soils contain different amounts of sand, silt, and clay. Sand, silt, and clay are different from each other mainly in the size of the particles. For example: Sand particles range from 2 to .05 mm in diameter. Silt particles are .05 to .002 mm in diameter, and clay particles less than .002 mm in diameter. When the soil contains a high amount of sand, we call it sandy soil. If it contains a high amount of clay, the word "clay" is used in the name of the soil. The same is true for silt.

Soil texture is very important. It is related to the size of particles in the soil and this affects the use of the soil especially in the tillage operations. After practicing the feel of the different types of soil, it is possible to determine the texture. The following table is a rough guide for determining soil texture by feel. (SH, A)

NAME OF SOIL		DESCRIPTION
Sandy Soils*		Loose and porous when dry. Non-cloddy when wet. Feels rough and gritty between the fingers. Is easily worked between the fingers and by cultivation implements.
Silty Soils*		Slightly cloddy when dry. Clods crushed between fingers have a smooth feeling with little grittiness. When wet seems smooth, but not sticky. When powdery dry, it feels like ladies' talcum powder or prewar nylon hose.
Clay Soils*		Sticky when wet, cloddy when dry, ribbons out between thumb and forefinger. Hard to work with cultivation implements.

*Greatly enlarged

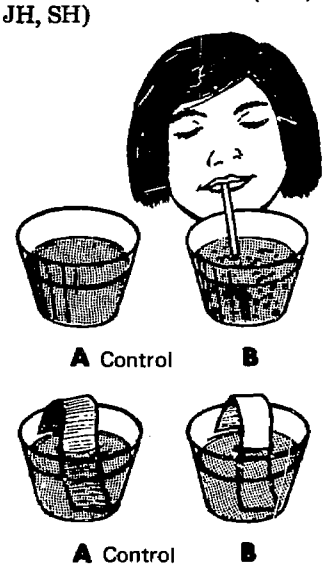
48. MAKE A MODEL FARM

Make a model farm out of a small lot say 50′ by 100′. This is an extensive project and will take a tremendous amount of planning and activities on the part of both teachers and students. To be most effective it is suggested that a replica be made of a typical farm in the area where a number of conservation practices are applied.

Such items as steep slopes, shallow rocky soil, severe erosion, and gullies can be effectively shown. How these problems can be treated can be illustrated by contouring, soil building crops, seeded water-ways, terracing, strip cropping, dams and etc. (SH, A)

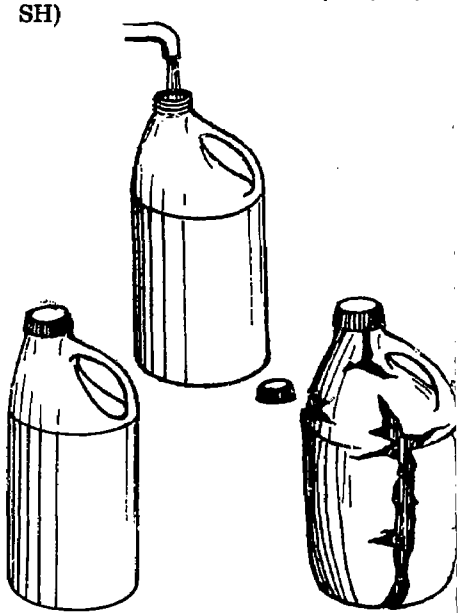
49. CARBON DIOXIDE IN THE ATMOSPHERE

Take two jars, label one the control and the other the experimental jar. With a straw, bubble some of your exhaled air into the experimental jar of water. Test both jars with blue litmus paper. What happens to the blue litmus paper? What does this tell you about the mixture of carbon dioxide and water? How does this happen in nature and what effect does this have on the earth? (PRI, INT, JH, SH)



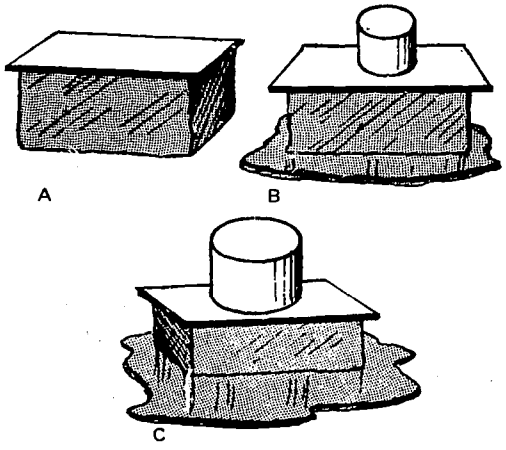
50. WEATHERING OF THE EARTH'S CRUST

Get an empty plastic bottle with a screw-on lid. Fill it to the very top with water and screw the cap on tightly. Place in a freezing compartment of a refrigerator overnight. What happens to the bottle? What relationship does this have to the earth and the earth's crust? (PRI, JH, SH)



51. HOW DOES WEIGHT AFFECT MELTING?

Take three ice cubes of equal size and cover each with a piece of asbestos. Place a half-pound weight on ice cube "B" on top of the asbestos sheet. A full-pound weight is placed on Cube "C." Because no weight other than the asbestos sheet has been added to Cube "A" it is called the control. As the cubes begin to melt, continually watch as to which melts the fastest. Why? Where in nature might this same principle, displayed by the fastest of the melting cubes, be found? (PRI, JH, SH)



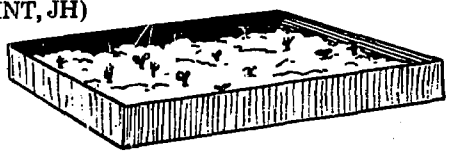
NOTES

B.

Activities Related to Plants and Plant Life

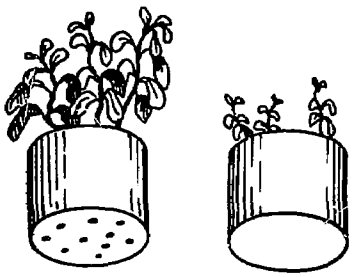
52. SOIL MAY CONTAIN SEEDS

Place some topsoil in a box and keep damp. In a few days small plants may appear on the top of the soil. (PRI, INT, JH)



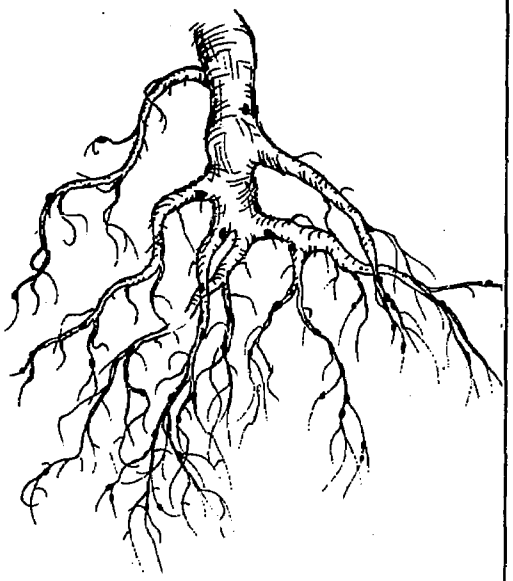
53. DRAINAGE OF SOIL IS NECESSARY FOR GOOD PLANT GROWTH

Take two tin cans and make several holes in one can. Fill both cans with the same kind of soil. Plant three seeds of peas or beans in each can. Place the can with the holes over a dish for drainage. Pour the same amount of water in each can. The can with the holes will show better growth. The soil in the other can will be too saturated with water for the plant to grow very much. (INT, JH)



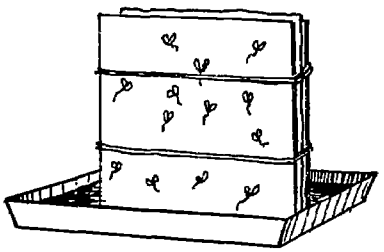
54. STUDY LEGUMES

Collect root specimens of various legumes and study the nodule formations. (Legumes are plants which bear their seeds in pods, such as beans, peas). Use legumes such as alfalfa, peas, beans, clover, etc. (JH, SH)



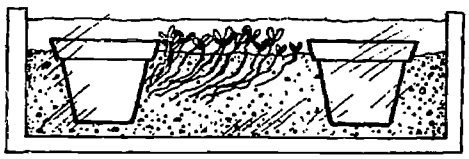
55. ROOTS TURN DOWN, STEMS TURN UP

Secure two pieces of glass the same size. Cut a piece of blotting paper this size and wet thoroughly. Sprinkle a few drops of five percent carbolic acid on the blotter to prevent growth of mold. Arrange seeds in many different positions on wet blotter. Place between glasses and tie these together securely. Stand glasses on edge in pan of water. The roots will turn down and the stems turn up when the seeds germinate. INT, JH)



56. ROOTS OF PLANTS GROW IN MOIST SOIL

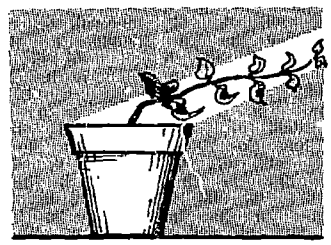
Construct a box approximately 14" long, 8" wide, and 5" deep, with a glass front. Place two 4-inch flower pots at opposite ends. The holes must be stoppered. Fill the box with earth. Plant a number of seeds near the glass and in various other places. Fill one flower pot with water and leave the other empty. Note the growth near the porous pot with water by observing through the glass front. In several weeks' time, remove the pots and notice which is surrounded by roots. (INT, JH)



57. PLANTS NEED LIGHT

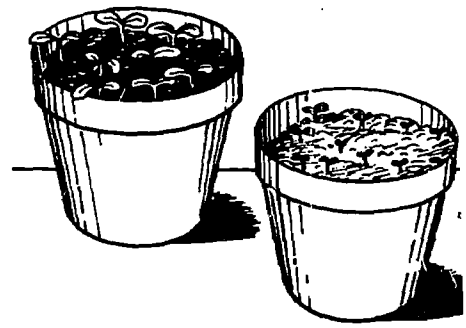
Place a growing potted seedling in a cardboard box which is larger than the plant, and cover. Cut a slot 1/4 inch by 4 inches in one side to permit the entrance of light. Keep watered and observe the effects of the light on the plant. Squash, corn, or beans are suggested. This can also be observed when onions or potatoes begin to sprout.

Place a small black envelope and one of clear white cellophane over two plant leaves which are not in full sunlight. Remove in a few days. Note the colors of the leaves due to the presence or absence of chlorophyll. (INT, JH)



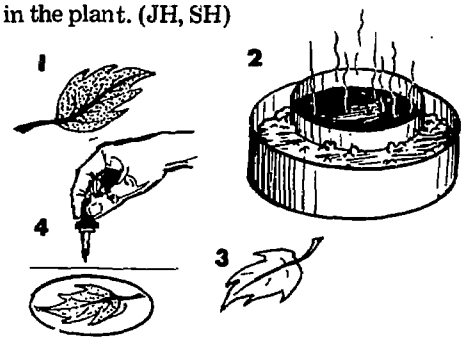
58. PLANTS NEED SOIL AND WATER IN ORDER TO GROW

Plant seeds in a pot of garden soil and water when necessary. Plant the same kind of seeds in the same kind of soil but do not water these. Observe sprouting and growth affected by the presence or lack of water. (PRI, INT)



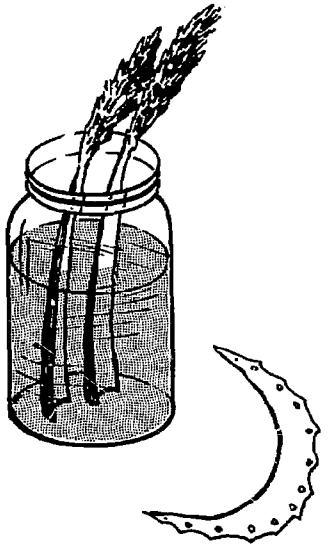
59. GREEN PLANTS MAKE FOOD WHEN IN SUNSHINE

To a small glass of water add 15 drops of iodine. Note the color of the water. Drop a piece of white potato or cracker into the water. A blue color should appear. This shows starch is present. Then drop a leaf into boiling water for one or two minutes to kill it. Put two tablespoons of alcohol (rubbing) into a small dish and then place the dish into a larger one of water. (This prevents danger of fire from the alcohol boiling over.) Boil the water to heat the alcohol. Heat the leaf until all the green color has gone out of the leaf into the alcohol. Remove the leaf and place it on a saucer. Pour iodine over it. Allow several minutes for the complete change to occur. The blue color indicates starch food in the plant. (JH, SH)



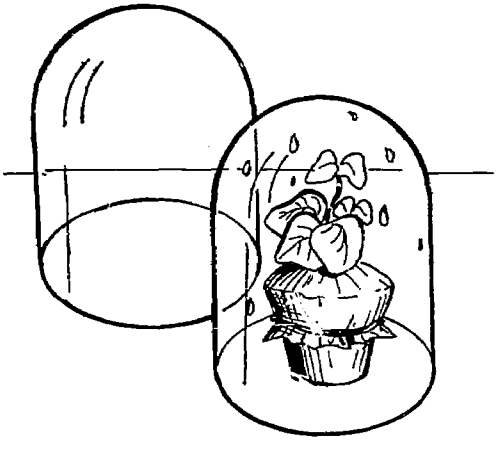
60. PARTS OF A PLANT RECEIVE WATER BECAUSE OF CAPILLARY ACTION

Add vegetable coloring or red ink to a jar of water. Then put fresh outer stalks of celery or white flowers into the water. Soon the red liquid will rise. Cut a cross-section and notice that only definite cell fibers conduct the liquid up toward the leaves. (JH, SH)



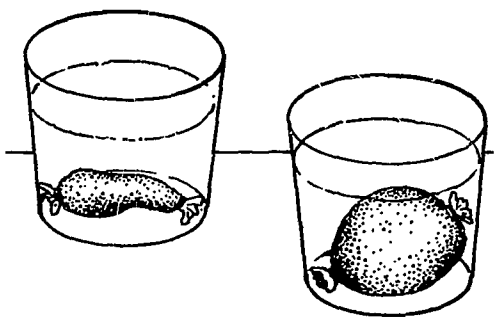
61. PLANTS IN SUNLIGHT GIVE OFF WATER

Cover the pot of a growing begonia or geranium with waxed paper and fasten the paper securely around stem. Invert a glass jar over the plant and place in sunlight. In a few hours, drops of water will appear inside the glass. To prove that the plant does give off moisture, invert another glass jar of the same size without a plant next to the one with the plant. (INT, JH, SH)



62. WATER PASSES THROUGH A PERMEABLE MEMBRANE FROM WHERE THERE IS MORE WATER TO WHERE THERE IS LESS WATER (OSMOSIS)

Make a bag of animal membrane (such as a sausage casing). Partly fill it with molasses and tie it securely. Drop the bag in a tumbler of water. After several hours the bag will be very much larger because the water has moved from the outside where there was more water into the bag where there was less water or the contents are more dense. (water to molasses) (JH, SH)

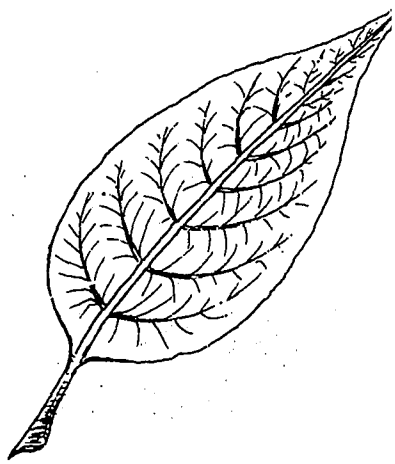


63. STUDY A PIECE OF ROOT

If you cannot conveniently get a piece of tree root, a radish, a beet, or a garden weed will do. Wash the soil from the root very carefully and see if you can discover any root hairs. Make a drawing of your specimen, showing the relationship of root, rootlet, and root hairs. (JH, SH)

64. EXAMINE A LEAF

Make a sketch of the underside of a green leaf. Draw in the veins, which act both as rods to support the leaf and as pipes to carry water and soluble mineral matter. Peel the thin skin off the undersurface of the leaf and examine it under a microscope. Notice the little openings through which carbon dioxide enters the leaf from the air. (JH, SH)

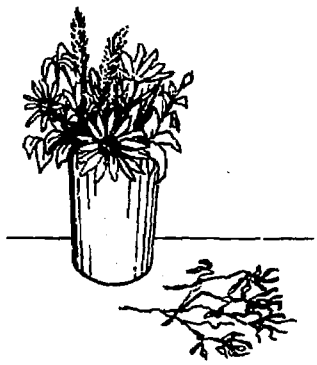


65. DETERMINE THE PRESENCE OF PROTEIN IN FOOD

Place a small piece of the white of a hard-boiled egg in a test tube. In another test tube place a small piece of potato. Add a drop or two of nitric acid to each test tube, being extremely careful not to spill any on your body or clothing. The egg white will turn yellow, but the potato will remain white. Next, add small amounts of ammonia to each test tube. The yellow color on the egg will change to orange, but the potato will still remain white. This test indicates that the egg white contains protein and that the potato does not. (SH)

66. PLANTS NEED WATER

Bring a bouquet of flowers to school. Divide it into two parts. Put one part in water and leave the other out. Which flowers look prettier at the end of the day? (PRI, INT)



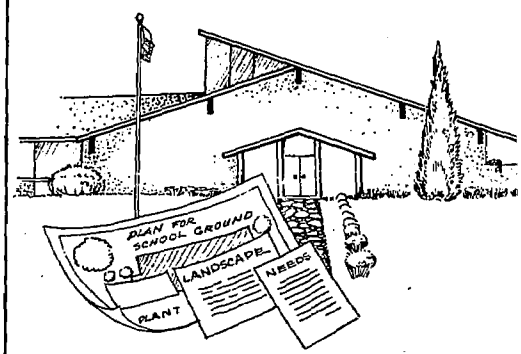
67. STUDY YOUR SCHOOL GROUNDS

Make a map of your school grounds. Study other school grounds. Plan together how to improve school grounds. (List needs)

a. Plant flowers, trees, and shrubs.

b. Plan and make a bird bath and fish pond.

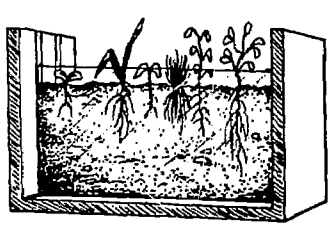
c. Sow grass where needed. (INT, JH)



68. STUDY THE GROWTH OF PLANTS

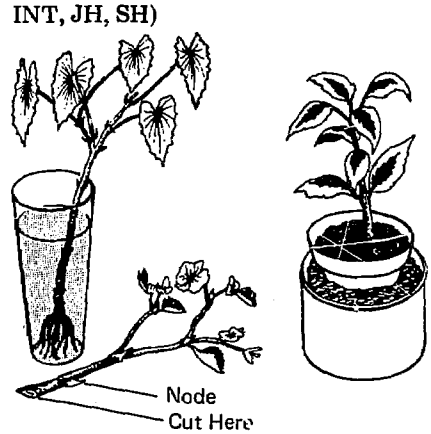
Construct a narrow glass planter by following the directions in the diagram. This planter is made of two panels of glass about 24" long and 12" high. These panels are mounted on a wooden base and fitted into slots in the wooden frame at each end. The glass panels are about 1" apart. This 1" space is then filled with soil and various seeds are planted. Care must be taken to water the soil frequently and in small amounts. A number of interesting observations can be made after planting the seeds. Which seeds sprout first? What plants have the longest roots? Can you see the root hairs? Do different plants have different kinds of roots?

This activity can be varied by inserting a partition and comparing the growth of plants in good topsoil and poor subsoil. Also small amounts of commercial fertilizers can be used to show how plants respond to additions of plant foods. Care must be taken not to use too much fertilizer. Perhaps 1 tsp. would be the maximum for each section of soil. (JH, SH)



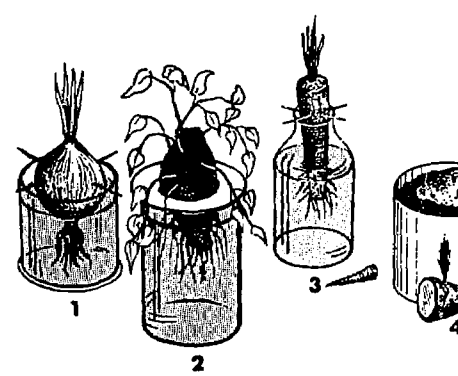
69. GROWING PLANTS FROM PARTS

Many plants that are grown indoors may be used to develop new plants. This project could be used several weeks prior to Christmas or Mothers Day to provide gifts. Examine several plants found in the classroom or at home. With a sharp knife or razor blade, make a diagonal cut across the stem, making certain that it contains the enlarged portions of the stem, called nodes. Two methods can be used: (1) place the plant in a jar of water, or (2) place plant in a pot of soil and place this pot in a coffee can full of absorbent material, such as vermiculite or sawdust. (PRI, INT, JH, SH)



70. GROWING ROOT PLANTS

Many plants can be started from their root stocks. Obtain them from your local food store. Several examples of these plants are the onion, carrots, sweet potato, or the potato. Various methods of suspending the roots in water can be used. Try toothpicks, pencils, etc. Note their rate of growth. Which grows the fastest? Where do the roots form? Do plants in nature form new root plants this way each year? (P, JH, SH)



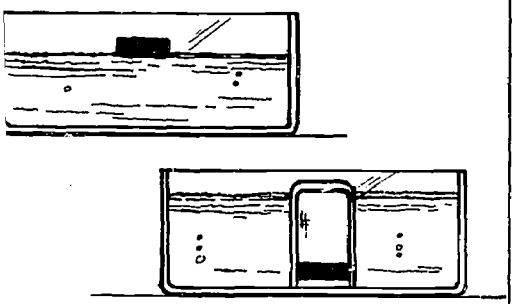
1. Onion suported by toothpicks.
2. Sweet potato.
3. Carrot with bottom cut off.
4. Potato slice with eye.

C.

Activities Related to Weather, Air, and Climate

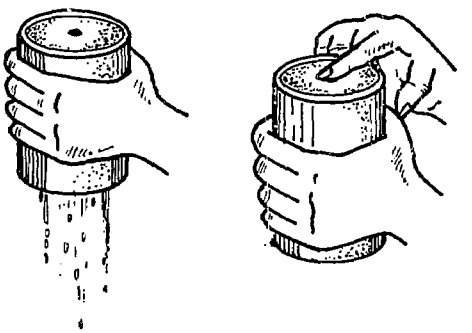
71. AIR OCCUPIES SPACE

Fill a large pan or glass tank with water. Float a cork on the water. Place an inverted tumbler over the cork, pushing cork to the bottom. The air occupying the space in the glass forces the cork and water down. (INT, JH)



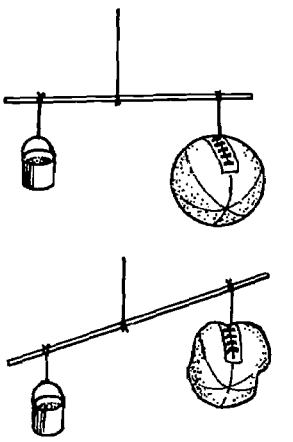
72. AIR PRESSES

Punch one small hole in the top and two more holes in the bottom of a can which is covered with a tight-fitting lid. Fill or partly fill the can with water. The water will run out of the bottom hole as long as the top is open. The air entering the hole presses against the water and forces it out. If the top hole is closed, the water stops flowing. This is due to the air pressure outside the can being greater than the pressure inside the can. (JH, SH)



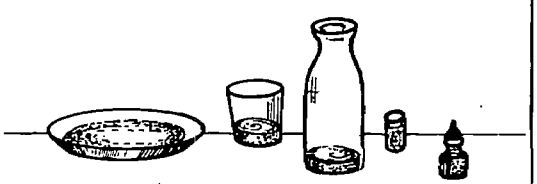
73. AIR PRESSES BECAUSE IT HAS WEIGHT

Drill holes in a 36-inch stick at the 6, 18, and 30-inch marks. Use the middle mark for suspending the stick. Tie a can on one side and a basketball on the other. Put sand in the can until there is a balance. Then release the air from the basketball. Note the lack of balance. This is due to the loss of weight because of the air let out of the basketball. (INT, JH)



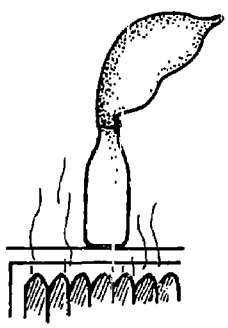
74. THERE IS WATER IN THE AIR

Use several containers of different shapes such as a pan, a glass, bottle, small bottle, and a bottle with a stopper. Pour equal amounts of water in each and place all containers under the same conditions. In a few days it is possible to see the amount of evaporation that has taken place in each, except the one with the stopper. The amount of evaporation is due to the amount of surface exposed to the air. (JH, SH)



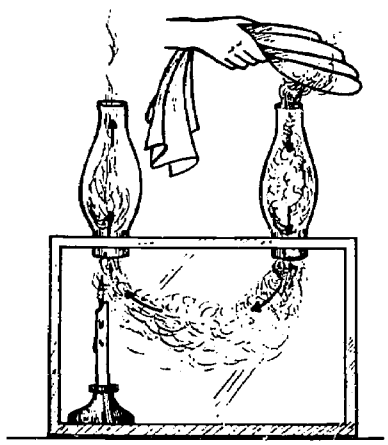
75. AIR EXPANDS WHEN HEATED

Fasten a rubber balloon over the mouth of a bottle. Heat the bottle by putting it on a radiator. The air in the bottle will expand and partially fill the balloon. (INT, JH)



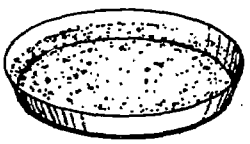
76. HEATED AIR IS PUSHED UP BY COLD AIR

Use a small wooden box with a glass front and two holes in the top over which lamp chimneys may be fitted. Fasten a candle to the box under one hole, light the candle and close the glass front. Set fire to a slightly dampened piece of towel that has been rolled rather lightly. By placing the smoking towel over first one chimney and then over the other, it is possible to trace the current or cold air and hot air. The heavy cold air flows down one chimney pushing the heated air up through the other. (JH. SH)



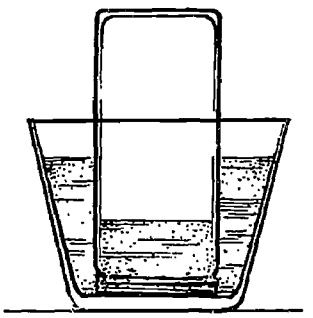
77. WATER MAY CONTAIN MINERAL MATTER

Fill a flat dish with water suspected of containing mineral matter. Allow the water to evaporate. The coating left on the dish consists of minerals found in the water. Also, notice the sediment formed in a tea kettle, where hard water has been used. Pour salt in water and allow to evaporate. Observe the deposit. (JH, SH)



78. BY OXIDATION, OXYGEN IS TAKEN FROM THE AIR

Fill an olive bottle with water. Empty it and put some iron filings or steel wool in the bottle. Shake until the filings cover the sides of the bottle. Place the bottle inverted in a glass of colored water. Leave for several days. The filings rust or oxidize. Because the oxygen in the air combines with the iron, much of the oxygen and pressure inside the jar is reduced. Therefore, the water rises in the jar to about one-fifth the height of the jar. This is due to the oxygen which comprised one-fifth of the air in the jar. (JH, SH)



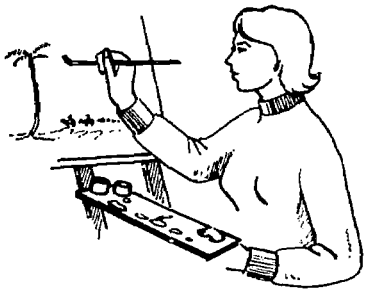
79. WHAT MAKES A DESERT

Obtain or make an outline map of the world. Locate all the large deserts and color in these areas with crayon. Find out the average annual rainfall in each of these desert regions and place this information on the map. (JH, SH)

80. CLIMATE AND ART

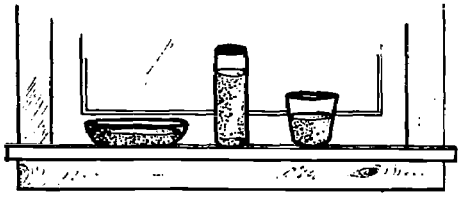
(a) Paint a scene to represent an oasis in a desert. Before you begin, find out what kinds of plants, animals, and people one might expect to see there. (JH, SH)

(b) Make a sketch to show a caravan moving across the desert. (JH, SH)



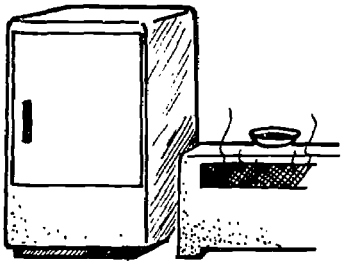
81. THE AMOUNT OF WATER SURFACE ESPOSED TO THE AIR INFLUENCES THE AMOUNT OF EVAPORATION

Choose three vessels: one flat and shallow like a cereal dish, the second tall like an olive bottle, the third an ordinary drinking glass. Put exactly two tablespoonfuls of water in each of the three vessels and place them on the window sill. Observe them each day for a few days. Which container goes dry first, which next, and which last? Does the amount of water surface exposed to the air influence the speed of evaporation? (INT, JH, SH)



82. THE EFFECT OF TEMPERATURE ON THE SPEED OF EVAPORATION

Place exactly two spoonfuls of water in each of two similar dishes. Put one dish on a warm radiator and the other in the refrigerator or some other cool place. Observe them after one day and after two days. Does warm water evaporate more or less rapidly than cold water? (INT, JH)



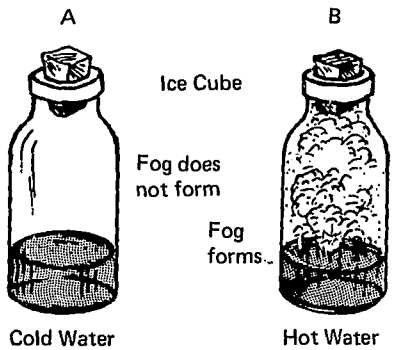
83. PROVE THAT THERE IS AIR IN SOIL

Pour some loose soil into a drinking glass until it is half full. Slowly pour water over the soil until the glass is almost full. What proof do you get of the presence or absence of air in the soil? (INT, JH, SH)

How to prove that there is air in wood: Tie a weight to a piece of unpainted wood and sink it in a vessel of water. Warm the water but do not let it boil. What proof do you get of the presence or absence of air in the wood? (INT, JH) (Refer to Activity No. 25)

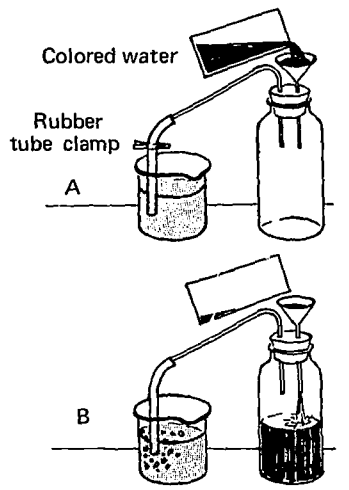
84. WATER IN OUR ATMOSPHERE?

Fill a glass milk bottle with hot water. Pour out the water, leaving about an inch in the bottom. Place an ice cube on the mouth of the bottle as illustrated in the diagram. Set up a second bottle as a control, using cold water instead of hot water. What happens in each of the bottles? Explain how these events relate to nature. Compare both the control bottle and the experimental bottle reactions to nature. (PRI, JH, SH)



85. ATMOSPHERIC AIR PRESSURE

Obtain a glass bottle, a small jar or beaker, glass tubing, a short piece of rubber tubing, tubing clamp, two-holed rubber stopper, funnel, and a small jar of colored water for this experiment. Fill the small jar with water and set up your materials as shown in the diagram. First, attach the clamp to the tube very tightly. What happens to colored water when poured into the funnel? What happens when the clamp is released? Explain this event. (PRI, INT, JH, SH)



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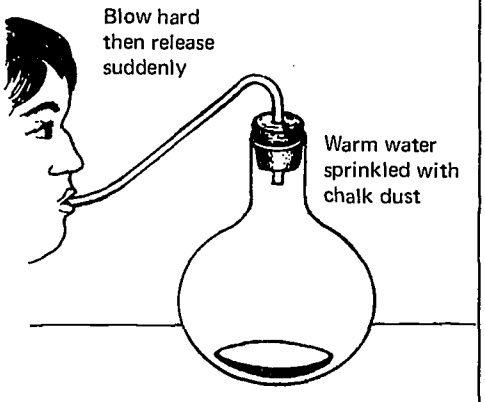
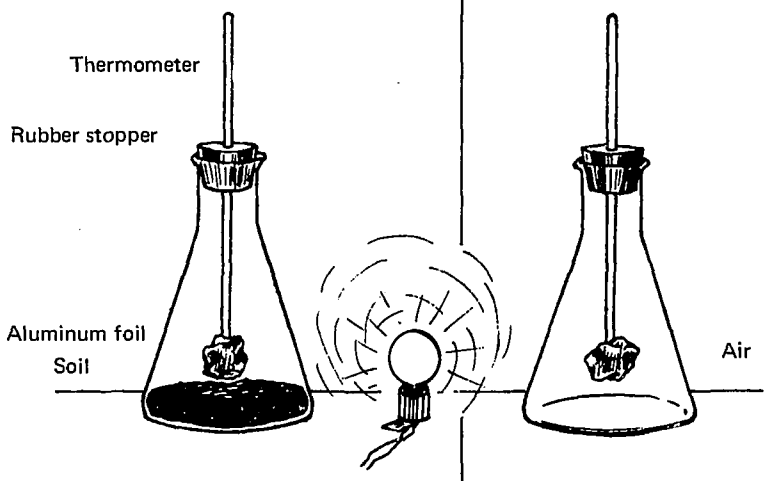
86. ATMOSPHERIC MOISTURE

Obtain from your chemistry teacher a piece of "S" shaped glass tubing, a rubber one-hole stopper, and a narrow, long-necked flask. Place in the bottom of the flask about 1 inch of warm water and sprinkle this with chalk dust from your eraser tray. Blow hard into the tube, then stop blowing suddenly. What happens inside the flask? What three conditions are necessary for the event to occur in nature? (JH, SH)



87. THE EFFECT OF LIGHT RAYS

Set up two flasks or bottles as shown by the diagram. Record any changes in temperature within Bottle A and Bottle B. Record the temperature at the beginning of the experiment and then continue each 5 minutes for 25 minutes. (JH, SH)

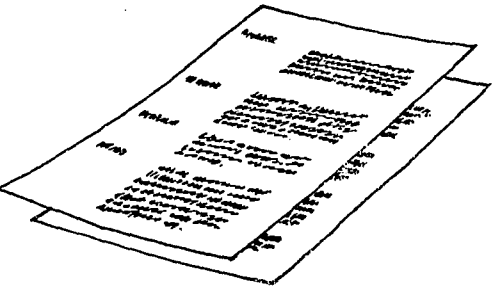


D

Activities Related to Fish, Wildlife, and Microscopic Life

88. WHAT MAKES SOIL PRODUCTIVE

On the left-hand side of a sheet of notepaper, list, about five spaces apart, one under the other, the words: bacteria, organic matter, water, air, and minerals. Opposite each, on the right hand side of the sheet, give one or more ways in which each contributes to the fertility or productivity of soil. In giving an oral explanation, after completing the exercise, cite an example in each case, if possible. (JH, SH)



89. FISH AND GAME LAWS

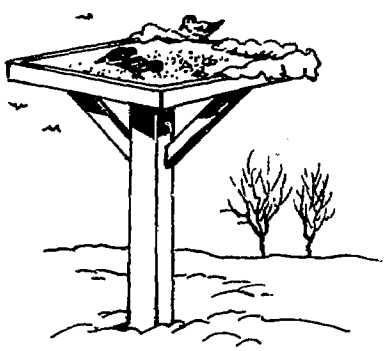
Find out what the game and fish laws, rules, and regulations and bag limits are for your State. (This information may be obtained from the State Fish and Game Commission and from the U. S. Fish and Wildlife Service, Washington D. C.) Are these regulations observed? If not, why not? Talk about these regulations with men who hunt and fish. Discuss your findings in class. (JH, SH)

90. HOMES FOR BIRDS

Build bird houses according to correct dimensions and hang or place them in trees or on poles or fences high enough from the ground to protect them from cats, weasels, or any other animals that stalk and kill small birds. (JH, SH)

91. FEEDING BIRDS

Build feeding stations and erect them in a place suitable for attracting and feeding birds, such as your own school, a nearby park or in the woods. See that they are constantly kept stocked with a variety of suitable food, water, and sand or crushed oyster shells throughout the winter season. Suitable foods for birds include seeds of all kinds, weed seeds, wheat, barley, oats, corn, et. (JH, SH)

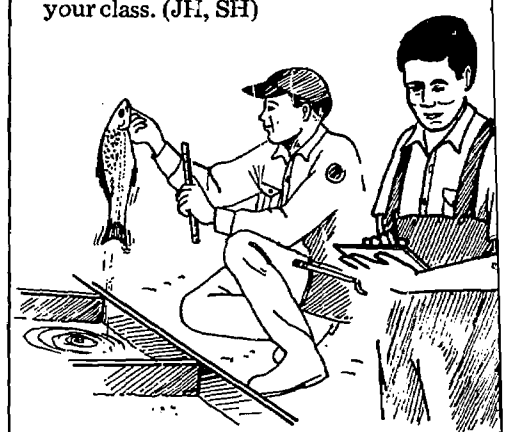


92. CONVERSATION WITH A HUNTER

Talk to some duck hunter with whom you are acquainted, or have him talk to the class. Write the most interesting story or incident he tells you in the form of a feature article such as might appear in your local paper or some outdoor magazine. (INT, JH, SH)

93. A VISIT TO THE FISH HATCHERY

Visit the State or Federal fish hatchery nearest your home. What species of fish are produced? At what season of the year are they released? How are they released? How large are the fish at the time they are planted? How are the fish fed at the hatchery? These are just a few of the questions that will occur to you if you plan to make a complete report to the members of your class. (JH, SH)

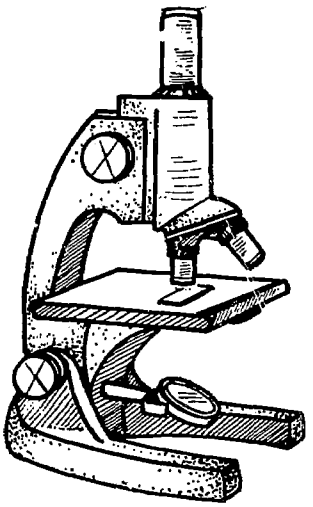


94. HOW TO MAKE AN AQUARIUM

Place an inch or more of coarse sand or gravel on the bottom of a watertight globe or tank. Get some water plants from a pond or a fish store. The tall grass-like Vallisneria is especially good because its leaves give off much oxygen in sunlight, and the oxygen will purify the water. Push the roots well into the sand. Add some floating water plants if possible. Fill the globe or tank with water to within an inch of the top. It should then be left for a week or more, so that air bubbles and other gases will have escaped. Next add the animals. The kind and number you choose will depend on conditions. Sunfish, catfish, young eels, or minnows are good. Salamanders, snails, or tadpoles may have a place. Turtles and water beetles are not desirable because they are likely to eat or injure the fish. If salamanders are used, be sure the aquarium has a glass cover. Do not put too many animals in your aquarium. (JH, SH)

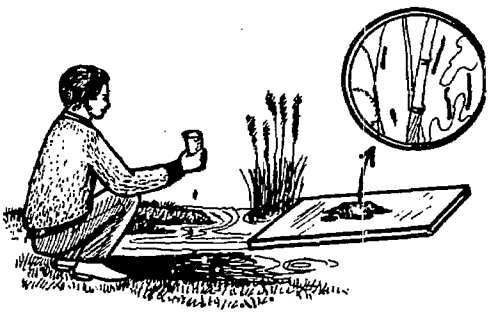
95. HOW TO BREED MICROSCOPIC CREATURES

Put some hay or grass in water, and leave it in a warm place for two or three days. Put a little cotton on a glass microscope slide. Take up some water with a medicine-dropper and squeeze two or three drops on the cotton. Cover the cotton with another microscope slide and place it under a microscope. Focus the microscope and you will see several kinds of tiny living creatures. (JH, SH)



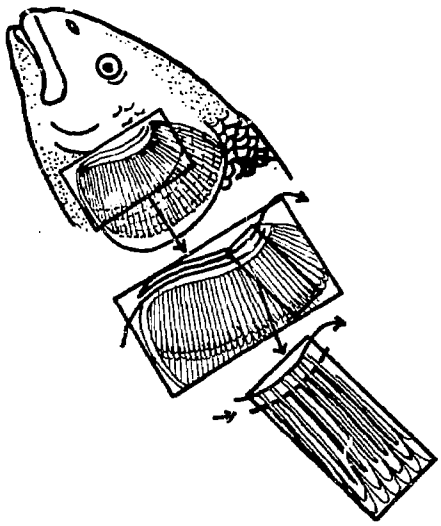
96. LIFE IN A MUD PUDDLE

Prepare a slide containing a few drops of water from a roadside mud puddle. Are there microscopic creatures in this water? If so, how do they compare in number, shape, and habit with the creatures you studied in the preceding exercise? (JH, SH)



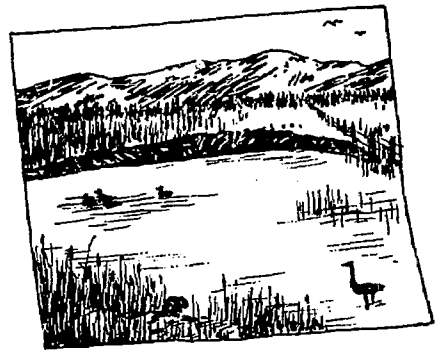
97. HOW A FISH BREATHES

Get a fish's head from a fish you have caught or from a fish market. Cut it open carefully so that you can see the gills. Notice how beautifully they are designed for straining the air from the water. (JH, SH)



98. WILDLIFE AND ART

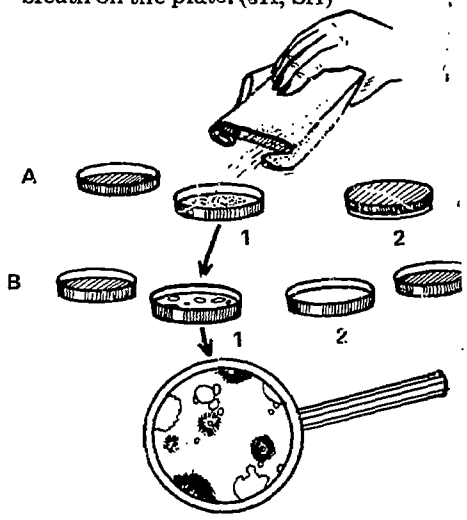
Sketch a scene to show typical pond life. This may be a pond or lake you have visited or seen on the screen. Include: shrubs, trees, water plants, insects, frogs, toads, birds, ducks, geese, animals, etc. (JH, SH)

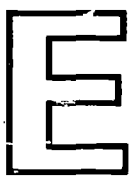


99. HOW TO GROW BACTERIA

Boil a cupful of beef broth for two or three minutes to kill all the bacteria it may contain. Then add a teaspoonful of gelatin so that when the mixture cools it will form a jellylike mass. Pour half the mixture into one flat dish and the other half into another flat dish. Cover the dishes and let them cool. Next, lift the cover of one dish and shake a soiled handkerchief over it. Replace the cover. Keep the second dish tightly covered. Place both dishes in a warm place for a few days. Observe the dishes from time to time. After a few days the mixture in the dish over which you shook the handkerchief will probably have little spots on its surface, as shown. The mixture in the other dish should remain clean. As time passes, the spots grow larger and larger. Each spot is composed of many thousands of bacteria.

Repeat experiment using cions, dishcloths, kissing, or blowing breath on the plate. (JH, SH)

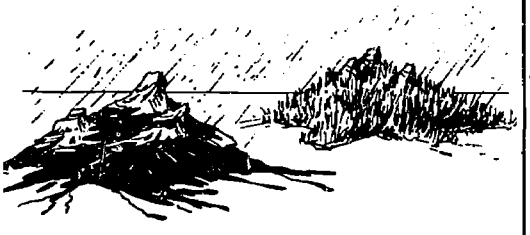




Activities Related to Forests, Rangeland, and Watershed

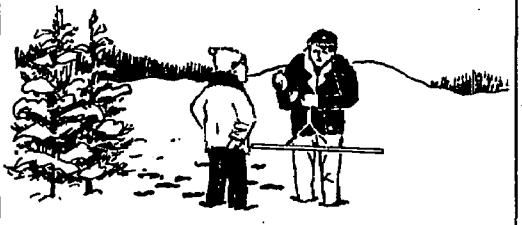
100. WATERSHED

Build two watersheds on pans or sandtable in classroom. Start with two or three jagged rocks; add smaller rocks and gravel, allowing it to fall in crevices. Add topsoil. On one watershed, press down strips of grass sod so that entire watershed, except sharp tops that protrude, is covered with grass. Turn electric fan on the other watershed that has no grass; then on the grass-covered watershed. Note wind erosion or lack of it. Pour water on bare watershed. Note loss of water and soil. Pour water on grass covered watershed. Note absorption of water, no loss of soil. (PRI, INT)



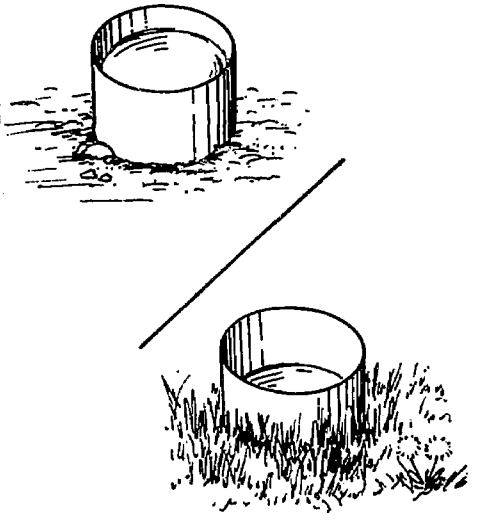
101. MEASURE PRECIPITATION AND TEMPERATURES

Contact the U. S. Weather Bureau or your closest weather station to learn how rain and snow are measured. Have the metal shop at your school build a simple rain gauge. Write to Superintendent of Documents, Government Printing Offices, Washington, D. C., for a copy of **Instructions for Cooperative Observers, Circulars B & C,** Instrument Division; 10 cents a copy. (INT, JH)



102. INFILTRATION

Cut tops and bottoms from two 1-gallon cans. Take to an area where you can press one can firmly into ground which has been bare of vegetation for some time and is compact. This may be near your classroom. Place the other firmly in ground well covered with plants. Fill both with water. Note the time it takes for water to be absorbed in each area. (INT, JH)



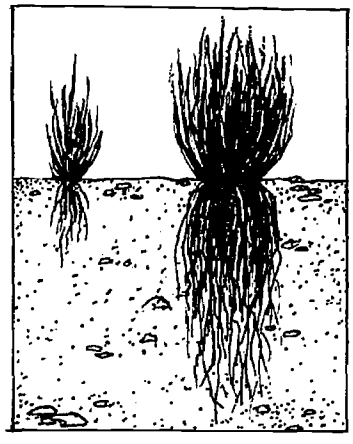
103. LEAVES ARE FOOD FACTORIES

Prepare two boxes of good soil at least 6 inches deep. Plant perennial grass seeds (such as tall wheatgrass) about one inch apart. After the plants begin to grow, thin out until you have just enough to make a few clumps of grass. The number of clumps will depend upon the size of the box. Water both boxes as necessary to make good growth. After plants are well established, with several shoots on each plant, start clipping three-fourths of each blade of grass in one box. (Blades of grass are leaves.) Do not clip the grass in the other box. Give the same amount of water to each box. Bunch grass does not require as much water as some plants, but keep moist enough to keep growing.

At the end of three months, stop clipping and let grass grow naturally in both boxes for one week. Then take some of the bunches of grass from each box. Cut around them and lift out gently, washing the dirt from the roots very carefully so that the fine roots will not be broken. You may need to add a lot of water to the soil before you try to lift the bunches of grass out.

Mount a clump of grass from one box on a piece of cardboard, besides a clump from the other box. Note the difference in growth of tops and roots.

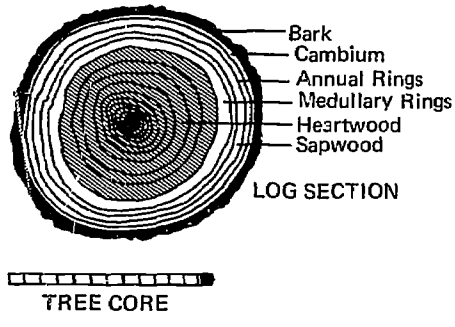
CONCLUSION: Plants need not only good soil, water, and sunshine to grow; they need green leaves to manufacture the plant food that makes them grow. When too many green leaves are removed, the roots are starved, and the plants cannot produce tops. (JH, SH, A)



104. HOW A TREE GROWS

Bring a section of log into the classroom. Foresters or a sawmill owner will cooperate to furnish the section. Count the rings to determine the age of tree. Examine the width of rings to see which were good and which were poor growing years. Look for evidence of disease or injury to the tree. Label the rings for historical events. Obtain the Forest Service chart, How a Tree Grows, from your nearest Regional Forester.

On a field trip with Forest Ranger or Forester, demonstrate the use of an increment borer. Take a core from a vigorous, thrifty tree; note annual growth rings. Take another core from overmature or suppressed tree; note difference in annual growth rings. (JH, SH, A)

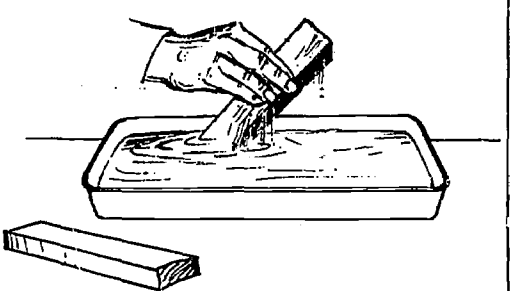


105. WHAT WE GET FROM TREES

Make a classroom bulletin board of forest products or use a discarded Christmas tree to display the products themselves or pictures of them. You can get the U. S. Forest Service chart entitled What We Get From Trees from your nearest Regional Forester, U. S. Forest Service. (PRI, INT)

106. FIRE

(a) Moisture content of forest fire fuel is one factor which determines how fast a fire will spread. Cut two sticks of kindling wood, 12" long. Weigh both on accurate scales (should weigh approximately the same). Number one stick "1" and the other "2". Make note of weights. Dry one stick out thoroughly in the sunshine; soak the other in water for several hours. Weigh again. Which stick would now burn faster? When is danger of spread of forest fires greatest? (INT, JH, SH)



(b) Forest fires require oxygen and fuel. Build a safe campfire. Put it out, reducing flame by cutting off oxygen with water or dirt. (INT, JH, SH, A)

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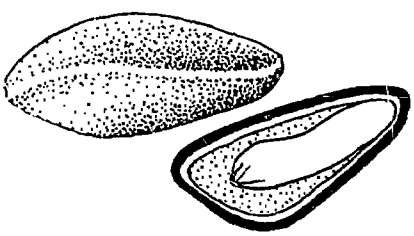
107. TREE PLANTING

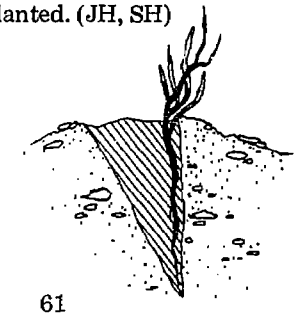
To be done under supervision of trained forester.

(a) Examine a few seeds taken from ripe cones. The forester will help you decide when they are ripe. Remove hard seed coat carefully. Inside the brown, papery inner coat there is a whitish endosperm which contains the stored food and the embryo necessary for the seed to grow into a tree. The stored food is in the form of carbohydrates, proteins, and fats. Compare to bread, meat, and butter. (INT, JH)



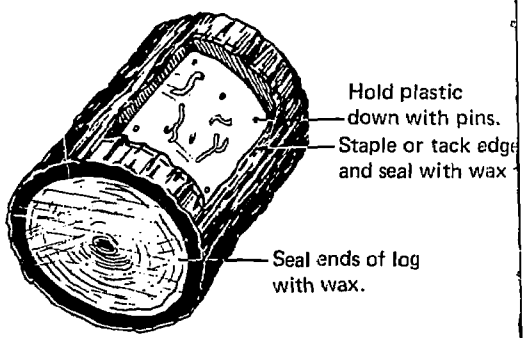
(b) Plant tree seeds experimentally. (This project can extend over several years.) Extract tree seeds by drying cones. Plant according to instructions from Forester or Forest Ranger. Keep a chart of the number of seeds planted; figure percent of germination. (JH, SH)

(c) Enlist help of Forester, Forest Ranger, or County Agent in field planting of seedlings when they are two or three years old. Follow instructions carefully. Check plantation every year until trees are five years old. Figure percentage of survival on the basis of total trees planted; on the basis of total seeds planted. (JH, SH)



108. FOREST INSECTS

(a) Beetles: Enlist the help of Forester or Forest Ranger in identifying beetle-infested forest trees. Collect a log section (billet) of such a tree in autumn. Peel or shave bark down very carefully to expose insects. Apply plastic window. Keep in dark, warm room, except for observations. Wax the cut ends of the log. Watch development from larvae to pupae to adults. Adults will cut through the plastic to try to get out to infest other trees. Cut a green log of same tree species, peel down to cambium layer, insert adults in pairs (one large, one small) and cover with plastic sheets. Watch development this time

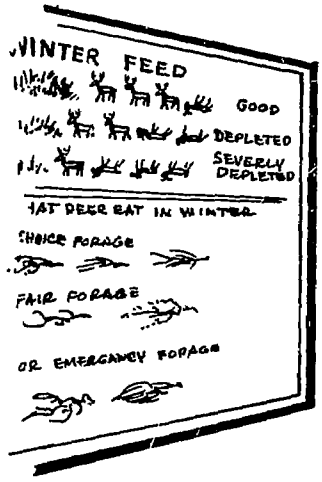


from egg stage. (Beetles kill by larvae feeding which girdles the tree, cutting off its "supply" line from roots to needles, and by blue stem fungi which the adults carry into the tree with them when they attack.) (PRI, INT, JH, SH, A)

(b) **Tent Caterpillar:** Collect eggs in fall from trees or shrubs. Store eggs on branches in cardboard box in dry, cold storage. When aspen and cottonwood trees start to leaf out in the spring, bring branches and leaves into the classroom. Place in large glass jar. Take caterpillar eggs from storage and put into jar with foliage. Cover jar mouth with muslin. Add fresh green foliage as needed. Watch eggs develop into caterpillar and devour foliage. (Tent caterpillar, by destroying foliage, reduces growth, health, and vigor of the tree. If leaves are eaten off several years in a row, the tree may be killed.) (PRI, INT, JH)

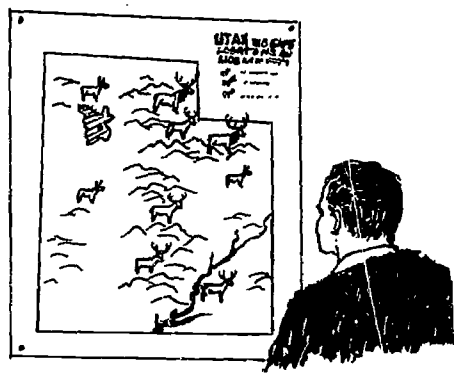
109. DEER WINTER FEED

Under the supervision of a wildlife manager, collect specimens of deer winter feed. Get some of each: choice, fair, and poor or emergency feed. Make a classroom display board relating lack of winter feed to winter deer losses. Deer can be made of cork and pipe cleaners. (INT, JH, SH)



110. WILD ANIMAL MAPS

Make maps of different States, showing location of different animals such as deer, elk, antelope, mountain goat, moose, and mountain sheep. Cut out pictures or use student drawings to illustrate map. (INT, JH)

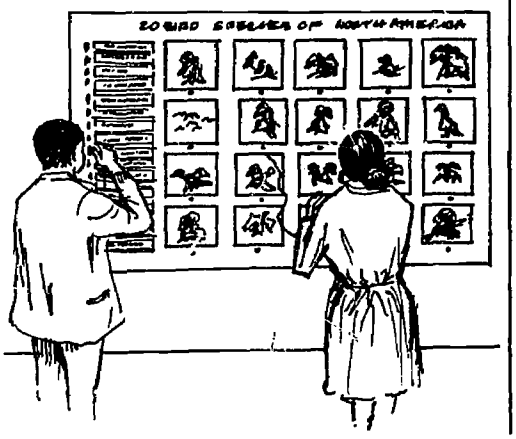


111. STREAM BANK IMPROVEMENT

Plant willow cuttings along stream banks that are washing away. Do not plant on privately owned land without permission or on irrigation ditches. Willows planted on other streams protect the banks and improve the streams for fish. They also provide homes for wild animals useful to man. (JH, SH, A)

112. ELECTRIC IDENTIFICATION BOARDS

Erect a board large enough to hold pictures or drawings of 20 species of birds, wild animals, trees or plants, or a combination of these. Place names on the left, each with a metal contact alongside. Run a wire from the name (on the back of the board) to the clip which holds a picture. Wires held by students run to the battery, to the bulb. If the correct name for any animal, bird, tree, or plant is selected, the bulb will be lighted. (Courtesy Vernon G. Carter, Education Director, National Wildlife Federation.) (INT, JH, SH)



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